## 21 Modeling with Linear Functions. Scatterplots

Due:
**12/14/2015 at 06:00am EST.**

Students will be able to:

- Use linear functions to model real-life situations
- Use data and technology to produce least-squares regression line, and interpret the findings

**Functions and symbols that WeBWorK understands.**

**Links to some useful WeBWorK pages for students**

**1.** (1 pt) The temperature of the soil is 28 °C at the surface and decreases by 0.08 °C for each centimeter below the surface. Express temperature $T$, in degrees Celsius, as a function of depth $d$, in centimeters, below the surface. Enter your answer as an equation with $T$ on the left side, and an expression involving $d$ on the right.

**2.** (1 pt) A homing pigeon starts 600 miles from home and flies 50 miles toward home each day. Express the distance from home $D$, in miles, as a function of the number of days $d$. Enter your answer as an equation with $D$ on the left side, and an expression involving $d$ on the right.

**3.** (1 pt) You buy a saguaro cactus 9 feet high and it grows at a rate of 0.6 inches each year. Express its height $h$, in inches, as a function of time $t$, in years, since the purchase. Enter your answer as an equation with $h$ on the left side, and an expression involving $t$ on the right.

**4.** (1 pt) The table below gives the data on hand strength collected from college freshman using a grip meter. The preferred row gives the hand strength of each student's preferred hand while the nonpreferred column gives the hand strength of their nonpreferred hand.

| Preferred | 49 | 54 | 30 | 27 | 26 | 25 | 52 | 20 | 45 | 45 |
|---|---|---|---|---|---|---|---|---|---|---|
| Nonpreferred | 41 | 50 | 27 | 24 | 20 | 27 | 48 | 19 | 43 | 42 |

| Preferred | 39 | 28 | 47 | 53 | 21 | 32 | 28 | 52 | 40 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|
| Nonpreferred | 31 | 25 | 45 | 45 | 21 | 29 | 22 | 49 | 40 | 30 |

(a) Use a calculator or computer to find the least squares regression line, $y = mx + b$, where the independent variable $x$ denotes the grip strength of the preferred hand and the dependent variable $y$ denotes the grip strength of the nonpreferred hand. Enter the equation for the line below. (Use at least four decimal places in any constants in your answer.)
$y =$ _____

(b) What would the predicted grip strength in the nonpreferred hand be for a student with a preferred hand strength of 34 kg?
strength = ____ kg (round to nearest whole number)

(c) For each of the preferred grip strengths values, decided whether you would use extrapolation or interpolation to approximate the value of the corresponding nonpreferred grip strength.

(i) A preferred grip strength of 15 kg? ?
(ii) A preferred grip strength of 57 kg? ?
(iii) A preferred grip strength of 25 kg? ?
(iv) A preferred grip strength of 34 kg? ?

**5.** (1 pt) An ecologist tracked deer that were born in 1997. The number of deer, $d$, living each subsequent year is recorded in the table below:

| Year | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|---|---|---|---|---|---|---|---|---|---|
| Deer | 190 | 184 | 174 | 148 | 119 | 94 | 85 | 74 | 57 |

(a) Use a calculator or computer to find the least squares regression line, $d = mt + b$, where the independent variable denotes the number of years, $t$, after 1997. Enter the equation for the line below.
$d =$ _____

(b) What is the correlation coefficient of the regression line?
$r =$ _____
*(Enter r accurate to at least three decimal places.)*

(c) Interpret the slope, the vertical intercept, and the horizontal intercept of the line. Match one of the statements which best describes in practical terms each of these features:

___1. vertical intercept
___2. slope
___3. horizontal intercept

A. The total number of deer which have died between 1997 and 2005.
B. The number of deer in the initial population in 1997.
C. By what percent the initial deer population decreases each year.
D. How many years until all 190 deer have died.
E. 57 deer are still alive in 2005.
F. On average, the number of deer that die each year.
G. None of the above

**6.** (1 pt) The table below shows the IQ of ten students and the number of hours of TV each watches per week.

| IQ | 110 | 105 | 120 | 140 | 100 | 125 | 130 | 105 | 115 | 110 |
|---|---|---|---|---|---|---|---|---|---|---|
| TV | 9 | 10 | 10 | 2 | 14 | 9 | 7 | 7 | 11 | 2 |

(a) Use a calculator or computer to find the least squares regression line, $y = mx + b$, where the dependent variable $y$ denotes the number of hours of TV watched as a function of IQ, $x$. Enter the equation for the line below.

$y =$ _____

(b) What is the correlation coefficient of the regression line?

$r =$ _____

*(Enter r accurate to at least three decimal places.)*

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**7.** (1 pt) Find a formula for the linear function whose data is given in the table below.

| Year, t | 0 | 4 | 8 |
|---|---|---|---|
| Value of a computer, V | 1500 | 1260 | 1020 |

$V(t) =$ _____

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**8.** (1 pt) In a college meal plan you pay a membership fee, then all of your meals are at a fixed price per week. If 20 meals cost \$150 and 60 meals cost \$250 , answer the following questions:

a) Write a formula for the cost of a meal plan, $C$ , in terms of the number of meals, $n$ .

$C =$ _____

b) What is the membership fee? \$ _____

c) What is the price per meal? \$ _____ per meal

d) Find the cost for 40 meals. \$ _____

e) Find $n$ in terms of $C$ . $n =$ _____

f) Finally, use your answer in part (e) to determine the maximum number of meals you can buy on a budget of \$300. Maximum number of meals implies if you find that $n$ = 3.9, then you can buy a maximum of 3 meals. You must truncate any decimal solutions (which is different from rounding).

$n =$ _____ meals

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**9.** (1 pt) A theater manager graphed weekly profits as a function of the number of patrons and found that the relationship was linear. One week profit was \$10,856 when 1334 patrons attended. Another week 1504 patrons produced a profit of \$12,386.

(a) Find a formula for weekly profit, $y$, as a function of the number of patrons, $x$. Do not enter any commas in your formula.

$y =$ _____

(b) How much will profits increase if 1 more patron goes to the theater?

\$_____ (no comma in your answer)

(c) What number of patrons is closest to the break-even point (that is, the number of patrons for which there is as close to zero profit as possible)?

number = _____ patrons (no comma in your answer)

d) Find a formula for the number of patrons as a function of the profit. Do not enter any commas in your formula.

$x =$ _____

f) If the weekly profit was \$16,436, how many patrons attended the theater? number = _____ patrons (no comma in your answer)

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**10.** (1 pt) An empty champagne bottle is tossed from a hot-air balloon. Its upwards velocity is measured every second and recorded in the table below:

| t (sec) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| v (ft/sec) | 42 | 10 | -22 | -54 | -86 | -118 |

a) Find a formula for the velocity of the bottle as a function of the time since the bottle is tossed.

$v =$ _____

b) For each feature of the graph listed below, match one of the statments A-G which best explains its practical meaning.

___1. The $v$-intercept.

___2. The slope

___3. The $t$-intercept.

A. How fast the bottle is initially tossed upwards.
B. How much the velocity of the bottle decreases every second.
C. How much the bottle changes its position each second.
D. How long after tossing the bottle it starts to fall downwards.
E. The velocity of the bottle when it hits the ground.
F. How high the balloon is when the bottle is first tossed.
G. How long it takes for the bottle to hit the ground.